A Time-Delayed Model of Apis Mellifera

Western honey bees (*Apis Mellifera*) are pivotal role in human life. They are responsible for pollinating, which is worth $ 215 billion dollars annually over the world. And the price of honey bees' products grows up 2% in 2017. But the population of honey bees and colonies decline overtime. Our objective is constructing a delay differential equations (DDEs) to observe and predict the population of honey bees in the colony. Then we can investigate the Influential factors of the population. From data, we obviously observe the population has seasonality. We improve our basic model with seasonality. We take advantage of negative binomial method fit along with the Weighted Means method by R Studio. We find seasonality has smaller mean square errors (MSE) than basic model. And basic model is stable of populations. We predicted brood population better than adults. We think other factors influence adults population, and brood population is mainly influenced by internal factors.

Reference

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[2] Kristine M Smith, Elizabeth H Loh, Melinda K Rostal, Carlos M Zambrana-Torrelio, Luciana Mendiola, and Peter Daszak. Pathogens, pests, and economics: drivers of honey bee colony declines and losses. EcoHealth, 10(4):434-445, 2013.